

Consumers' Response to the 2006 Foodborne Illness Outbreak Linked to Spinach

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Baby Spinach

- Consumers responded to the Food and Drug Administration's September 2006 warnings to avoid eating spinach because of possible contamination with *E. coli* O157:H7.
- While spinach expenditures fell, consumers turned to other leafy greens as substitutes.
- The longer term drop in retail expenditures on fresh spinach products was almost matched by gains in expenditures on other leafy greens.



Charles Dharapak, Associated Press

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AMBER WAVES

It has been over 3 years since an outbreak of *Escherichia coli* O157:H7 prompted the U.S. Food and Drug Administration (FDA) to issue warnings about the safety of fresh bagged spinach and to advise consumers not to eat it. FDA's announcement had the potential to prevent additional illness, and the short-run consequences were clear. Less certain, however, were how long consumers would avoid spinach, the impact on consumption of other leafy greens, and the cost to the produce industry. While other foodborne illness outbreaks may provide some insight into consumer response, the actual response varies with the characteristics

of the commodity, outbreak, and information consumers receive (see "Peanut Processing and Sales Hold Steady After Peanut-Product Recalls" on page 4 for an example of consumer response to another outbreak).

The human costs of the outbreak linked to spinach were relatively easy to count. Consumers in 26 States and one Canadian Province fell ill, resulting in 204 illnesses, including 104 hospitalizations, 31 cases of hemolytic-uremic syndrome (a serious complication), and 3 deaths. It is now possible to look back at the outbreak and examine how consumers responded to the surprising news that eating spinach—a

food recommended by nutritionists—was linked to an outbreak. Did consumers make fine distinctions among foods based on new safety information?

ERS research revealed that consumers generally responded specifically to FDA's announcement; spinach sales plunged, but consumers did not panic about other vegetables. The short-term impact was a drop in demand for all leafy greens, as consumers briefly substituted other vegetables for leafy greens. Over the long term, consumers shifted purchases among leafy greens, but total expenditures for leafy greens did not change.

FDA Acted Quickly To Contain Outbreak

On September 14, 2006, FDA announced that consumers should not eat bagged spinach. Epidemiological evidence pointed to bagged spinach (fresh ready-to-eat spinach that comes into retail stores already in bags) as a possible cause of an ongoing multistate foodborne illness outbreak of the potentially deadly bacterium *E. coli* O157:H7. The next day, FDA expanded the warning to include all fresh spinach—both bulk and bagged. Bulk spinach refers to fresh spinach sold in bunches or loose for consumers to bag.

FDA had never made such a sweeping statement about U.S.-grown produce. Stores and restaurants immediately removed spinach from their shelves and menus. Spinach harvesting and marketing ceased, and there was no U.S. fresh spinach on the market for 5 days until FDA announced spinach grown in some areas was safe to consume. The main spinach production area was off the market for an additional 10 days until cleared by FDA.

FDA's announcement was unique in several ways. Typically, by the time an outbreak associated with fresh produce is detected and the contaminated item is identified, the outbreak is over and the product in question has long since been consumed or discarded. As a result, there is usually no benefit to warning consumers about consumption of contaminated fresh fruit and vegetables, and such warnings are rare. In contrast, the spinach warning occurred while the outbreak appeared to be ongoing and, in effect, created a daily conversation between FDA and the public that continued for weeks.

On September 29, FDA announced that "spinach on the shelves is as safe as it

was before this event." At that time, the contaminated product was no longer in the marketplace. While the FDA had identified the contaminated product—one brand of bagged spinach—it could not determine exactly how the spinach had become contaminated. It was not obvious that consumers would view the "all clear" as a call to return to their initial consumption patterns.

Uncertainty About Consumer Response to the Outbreak

In the wake of the outbreak, spinach growers faced considerable uncertainty, not knowing how far sales would fall, whether consumer demand would return to previous levels, and, if so, how long it would take. Amid massive publicity and temporary closure of the U.S. fresh spinach market, total fresh spinach sales declined. The magnitude and duration of consumers' response to the outbreak would depend on how consumers perceived their risk had changed.

It was even less certain how the spinach warning would affect consumption of lettuces, such as iceberg, leaf, and romaine, which make up the bulk of the leafy greens market. Consumers typically substitute one product for another based on relative prices; when spinach is expensive but romaine is cheap, consumers may buy romaine. However, consumers may also substitute based on food-safety characteristics. The FDA announcement surprised consumers and acted as a market shock that disrupted typical purchase patterns. In such a case, consumers may turn from spinach to another leafy greens product they think is safer—the other leafy greens product could be considered a *shock substitute*.

Although other leafy greens were not implicated in the outbreak, other bagged leafy greens have similar packaging and brand names and are displayed on the same shelves in grocery stores. Those

Shifts in consumer demand for leafy greens were occurring before the 2006 *E. coli* outbreak

Commodity	Share of leafy greens sales volume, 2005	Change in sales volume, 2004-05 ¹ 2005-06 ²	
		Percent	
Bagged spinach	7	7	11
Bulk spinach	2	-8	-3
Bagged salads without spinach	47	1	-6
Bulk iceberg lettuce	24	-3	-6
Other bulk lettuce	13	-2	-3
Romaine hearts	7	13	10
All leafy greens	NA	1	-3
All other vegetables	NA	3	0

NA=not applicable.

¹Comparison of January through December data.

²Comparison of January through August data.

Source: USDA, Economic Research Service using data from Information Resources, Inc. and FreshLook Marketing.

attributes could have led consumers to conclude that the similar-looking products were equally risky. Consumers might have reasoned that all other leafy greens were produced under similar growing and packing conditions, and consumption of these products would have fallen along with spinach. Similarly, the reputation of other bulk leafy greens might have also been tarnished by the spinach problem. In such a case, these products could be considered *shock complements*.

Total Consumer Expenditures Were Nearly Constant But Shifted Among Types of Leafy Greens

To investigate how consumers responded to the 2006 spinach food safety announcement, ERS used retail market scanner data for 2004-07—140 weeks before the spinach shock and 68 weeks after (including the week of the outbreak announcement). Researchers developed a model of consumer demand for six categories of leafy greens, including bagged and bulk spinach, and used standard statistical techniques to determine how consumer demand changed in response to the FDA warnings.

Many factors affected consumer behavior—new information on food safety, prices, seasonal patterns of leafy greens purchases, and long-term trends in the industry. The model results isolated the impact of the food safety warning about spinach and were used to simulate expenditures if the food safety shock had not occurred, as well as to simulate expenditures with the shock (see box, “Researchers Model Leafy Greens Demand”). With two consistently generated simulations, it was possible to calculate the changes in expenditures due to the outbreak.

Researchers Model Leafy Greens Demand

The ERS analysis used national, weekly point-of-sale retail scanner data, including weekly total expenditures and quantities purchased, and per pound prices. The data include large grocery stores but not mass merchandisers, such as Wal-Mart and Costco, farmers’ markets, or natural food stores. Retail scanner data include all food items scanned by grocery clerks. Because there is a wide range of products that vary by packaging, manufacturers, and degree of value added (bulk lettuce vs. ready-to-eat bagged salads), the scanner data were aggregated into six leafy greens products: bagged spinach, bulk spinach, bagged salads without spinach, bulk iceberg lettuce, other bulk lettuce, and romaine hearts. Bagged spinach includes bagged spinach intended as salad; bagged salads with spinach, including bagged spring mix, which often contains spinach; and bagged spinach that may have been intended for microwaving but could have been consumed as a salad. Bulk spinach includes bulk spinach and bulk spring mix.

The data covered a 4-year period, 140 weeks before the *E. coli* announcement and 68 weeks after (including the week of the outbreak announcement). Using a long data series allowed for separating the effects of prices and trends in leafy greens consumption and isolating the impact of the FDA announcement. ERS researchers used a demand model to estimate the effect of the shock and develop simulations of both expenditures following the shock and the expenditures if the shock had not occurred. The simulation comparison provides estimates of how far expenditures varied from what they would have been without the shock.

Including variables to represent the consumer response to the outbreak was challenging. Consumer response to the announcement could take many forms. Since the exact form the response might take was not known *a priori*, the model was designed to be flexible enough that market data would reveal the form. To that end, the model employed a set of five shock variables that together could highlight the effects of the FDA announcement on retail food demand. The response could be permanent or transitory. One permanent shock variable was included. Transitory responses could begin decaying immediately or could grow before decaying. Each type of transitory variable was included twice—one with a rapid decay rate and one with a slow decay rate.



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The analysis showed that consumers slightly reduced total leafy greens expenditures in favor of other vegetables but returned to their previous total leafy greens expenditure levels by 16 weeks after the outbreak was announced. The major change was a shift in expenditures among the six categories of leafy greens. Expenditures on all commodity groups except bagged salads without spinach showed a substantial immediate response, mostly in the first few weeks after the announcement. The magnitude and duration of the impact varied by commodity.

The maximum gap observed between simulated expenditures with and without the shock was for bagged spinach. Simulated expenditures fell 63 percent below where they would have been without the shock in the third week after the FDA announcement. Even after 26 weeks, simulated expenditures were still 17 percent below simulated spending if the *E. coli* outbreak had not occurred. By week 68 (the last week of data), simulated expenditures on bagged spinach were still down 10 percent, but the gap was narrowing.

In the first week of the outbreak, simulated expenditures for bulk spinach were 32 percent below what they would have been in the absence of the announcement. At week 26, simulated expenditures were still down 2 percent. By week 31, however, simulated bulk spinach expenditures were above what they would have been without a shock.

Consumers seemed to have faced two concerns—the safety of spinach in

Bulk spinach expenditures rebounded, but bagged spinach expenditures lagged

Commodity	Week ¹	Difference in expenditures ² Percent
Bagged spinach		
	Maximum difference—week 3	-63
	Difference at week 26	-17
	Difference at week 68	-10
Bulk spinach		
	Maximum difference—week 1	-32
	Difference at week 26	-2
	Difference at week 68	15
Bagged salads without spinach		
	Maximum difference—week 11	-4
	Difference at week 26	3
	Difference at week 68	3
Bulk iceberg lettuce		
	Maximum difference—week 1	13
	Difference at week 26	7
	Difference at week 68	5
Other bulk lettuce		
	Maximum difference—week 1	20
	Difference at week 26	6
	Difference at week 68	0
Romaine hearts		
	Maximum difference—week 1	13
	Difference at week 26	5
	Difference at week 68	-7
Total leafy greens		
	Maximum difference—week 1	-7
	Difference at week 26	0
	Difference at week 68	0

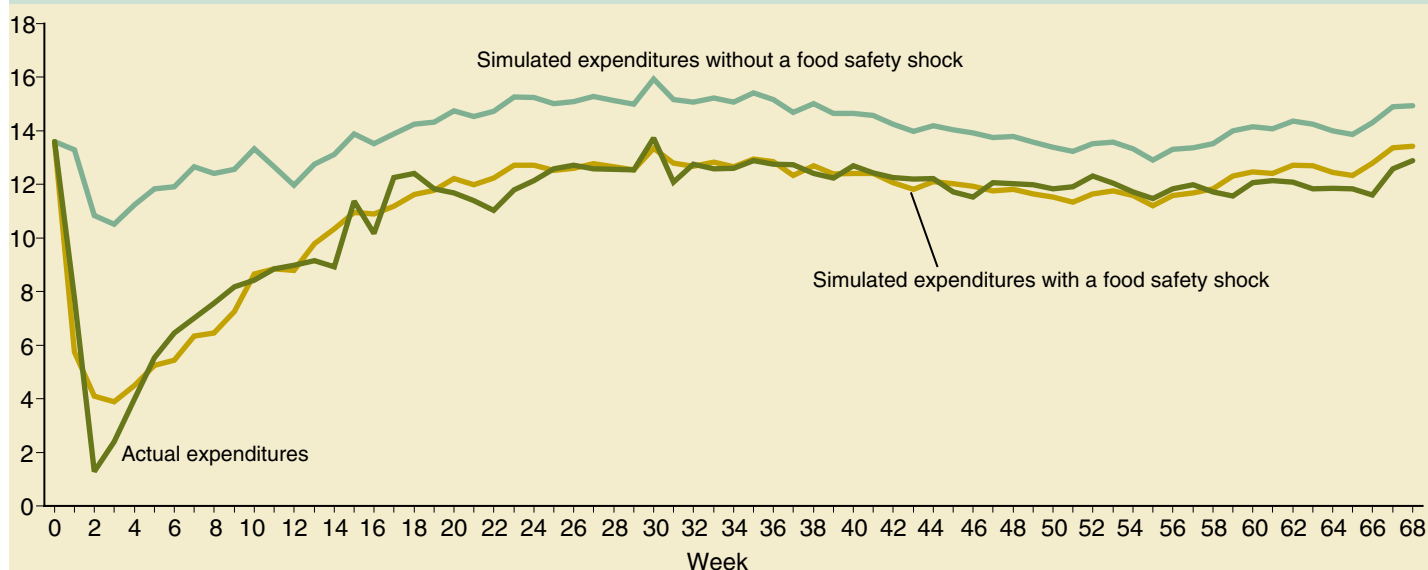
¹The outbreak announcement was made on Thursday of week 1. A week is defined as the Monday through Sunday sales week.

²Difference in simulated expenditures (with and without a shock) as a percent of simulated expenditure without a shock.

Source: USDA, Economic Research Service model results.

Bagged spinach expenditures plunged in response to FDA announcement, September 2006 - December 2007

Expenditures (\$ millions)



Note: Week zero is the week prior to and week 1 is the week of the announcement. Since the data are weekly and the 5 days when there was no spinach on the market were spread over weeks 1 and 2, the figure does not show actual expenditures falling to zero.

Source: USDA, Economic Research Service model results.

general and, more specifically, of bagged products. Although FDA warned about eating bagged and bulk spinach, the contaminated product was bagged spinach. Following the FDA announcement, several scientists were widely quoted in the media saying that the bagged salad production process was risky. Whether the statement was true or not, some consumers appeared to have viewed bulk spinach as the less risky of the two products. Sales of bulk spinach had been showing a long-term decline prior to the outbreak, but this trend was at least temporarily reversed following the *E. coli* outbreak. At the end of 68 weeks, simulated bulk-spinach expenditures were 15 percent above where they would have been without the outbreak.

Bulk iceberg lettuce, other bulk lettuce, and romaine hearts were clearly shock substitutes, as consumers spent more on these products following the announcement than they would have if there

had not been an outbreak. In the first week of the outbreak, simulated expenditures for these three products were 13-20 percent above what they would have been without a shock. By week 26, they were still 5-7 percent higher.

By the end of the 68-week period, consumer expenditures on bulk iceberg lettuce appeared to hold steady at about 5 percent above where they would have been without the shock. Consumer expenditures on other bulk lettuces continued a slow but persistent decline from their peak just after the outbreak; at the end of the 68-week period, simulated expenditures on these products were virtually unchanged from what they would have been if the outbreak had not occurred.

Bagged salads without spinach showed the most complicated response to the shock. In the first week of the outbreak, expenditures were up 1.5 percent—just barely a shock substitute. The change in

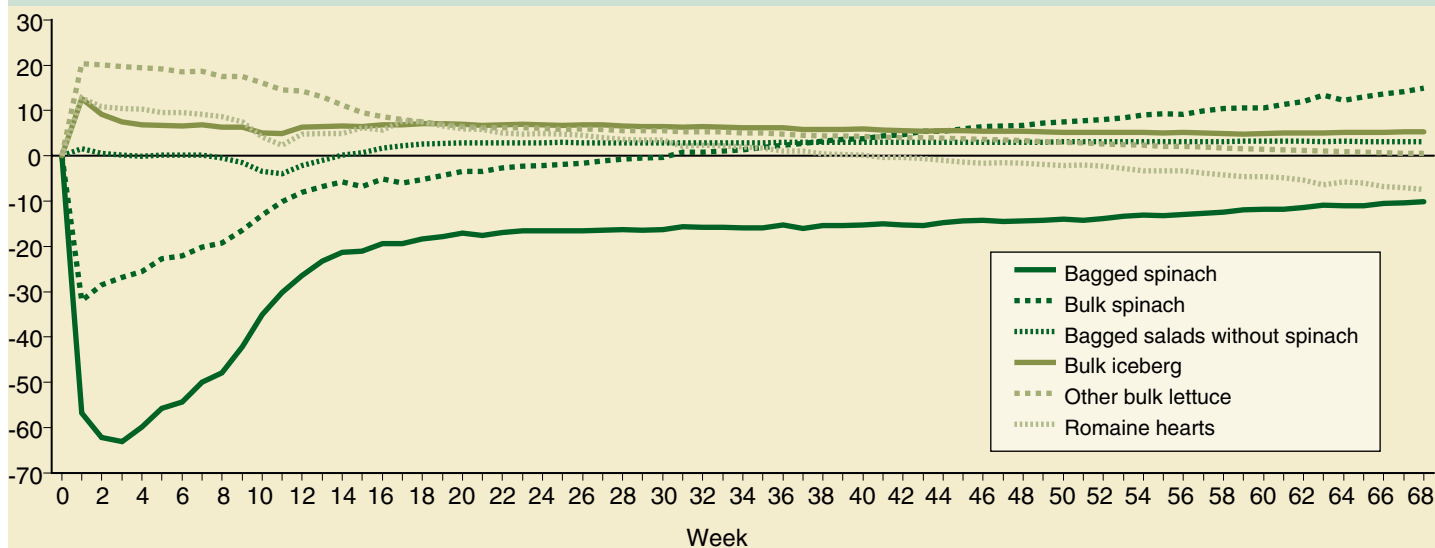
expenditures hovered around zero for the first 7 weeks followed by 6 weeks of expenditures below expected levels—a shock complement. Bagged salads without spinach were the only nonspinach product with declining expenditures shortly after the announcement, indicating that consumers were concerned about bagged products in general, not just spinach. By week 14, consumer expenditures for bagged salads without spinach increased above the no-announcement scenario, again becoming a shock substitute. Expenditures quickly settled into what appeared to be a longer term increase of about 3 percent.

Declining Spinach Expenditures Nearly Balanced by Increases in Other Leafy Greens

ERS researchers looked at the cumulative effect of the shock on expenditures over 68 weeks—from the FDA announcement to the end of the data series.

Consumer response to FDA announcement varied by type of leafy greens, September 2006 - December 2007

Percent change in simulated consumer expenditures



Note: Week zero is the week prior to and week 1 is the week of the announcement.

Source: USDA, Economic Research Service model results.

Expenditures were discounted over time to reflect a January 1, 2008, value.

- Total retail expenditures on bagged spinach declined \$201.9 million in the first 68 weeks after the FDA announcement—20 percent below simulated expenditures without a shock.
- Bulk-spinach expenditures fell \$0.6 million (1 percent), with a \$3.8 million loss over the first 30 weeks of the outbreak, followed by a gain of \$3.2 million in the last 38 weeks.
- Expenditures for bagged salads without spinach increased \$63 million, or 2 percent, including a net loss of \$3.9 million in the first 13 weeks of the outbreak (larger than the total loss of bulk spinach in 30 weeks), followed by a \$66.9 million gain.

- Expenditures on bulk iceberg increased 6 percent; other bulk lettuce, 7 percent; and romaine hearts, 2 percent.

- The sum of all changes in expenditures yielded a loss of \$60.6 million, a 1-percent decline in leafy greens expenditures below simulated expenditures without a shock.

The ERS analysis suggests that many consumers can and do use all the information they are given about product contamination to make fine distinctions among food products. The analysis of retail sales suggests that consumers rapidly responded to FDA's information. Understanding and using the relationship between information released by public health authorities and consumer behavior has important health as well as financial consequences. To minimize sales losses at the retail level, public health authorities may need to act as quickly as possible to provide consum-

ers all the information they have about which products are risky and which are not. *W*

This article is drawn from . . .

"Consumer Response to a Food Safety Shock: The 2006 Food-Borne Illness Outbreak of *E. coli* O157:H7 Linked to Spinach," by Carlos Arnade, Linda Calvin, and Fred Kuchler, in *Review of Agricultural Economics*, Vol. 31, No. 4, December 2009, pp. 734-750.

You may also be interested in . . .

"Outbreak Linked to Spinach Forces Reassessment of Food Safety Practices," by Linda Calvin, in *Amber Waves*, Vol. 5, Issue 3, USDA, Economic Research Service, June 2007, available at: www.ers.usda.gov/amberwaves/june07/features/spinach.htm